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NOTES FROM PACIFIC COAST OBSERVATORIES.

Polarization of the Light in the Solar Corona.

On account of the short duration of a solar eclipse and of the expense and difficulty in getting to the path of totality, our knowledge of the polarization of the light in the corona has advanced but slowly. When one considers, however, that a favorable eclipse lasts on the average only about four minutes and that few observatories have observed the corona at several eclipses, the advance seems remarkably rapid.

The accurate determination of the percentage of polarized light in the corona has an important bearing on the study of the distribution of the matter composing the Sun's atmosphere. To be of value, the polarization should be known for different distances from the Sun's limb. Heretofore the observations have been principally by visual methods and the shortness of totality would not permit such an extended program. To overcome the difficulty arising from the short duration of the eclipse, different observers have had resource in more recent years to photographic methods. Up to the present time, however, these have yielded qualitative rather than quantitative results. The following paper presents the results of measurements made by the writer from plates taken by Dr. Perrine, a member of the Crocker Expeditions sent out from the Lick Observatory, University of California, to observe the eclipses of 1901, 1905, and 1908. For a more complete discussion of the results the reader is referred to *Lick Observatory Bulletin,* No. 205.

Visual and photographic observations made at former eclipses have established the fact that the polarization of the coronal light is radial. This is also the case from a theoretical standpoint, if we assume that the light of the corona is due to scattering by small particles. We may make this clear by the following considerations:—

Let S be a source of light which emits the ray SP incident upon P. The vibrations of the ether wave lie in a plane perpendicular to SP. Consider P so small that the ether vibrations impart to it some of its own motion; the original ray passes on with diminished energy, while the particle becomes a source of light. We wish to study the character of the light scattered by P.

Let O be the observer and the angle SPO equal a right angle. The vibrations of P are executed in a plane through O and P perpendicular to SP. Only that component, however, which is perpendicular to the observer will be visible as light, for the eye cannot appreciate longitudinal vibrations. Hence scattered light, when viewed at right angles to the line of propagation of the original ray is plane polarized. The amplitude will vary at each succeeding instant so that the observed intensity will be due to a mean amplitude which we may denote by a.

Suppose now the angle $SPO = \alpha$. The amplitude of a will not be altered, but there will be another component of vibration perpendicular to a whose mean amplitude will be $a \cos \alpha$. The light which comes to an observer along any line from the corona is due to many particles for which the angle α is variable. For any line the component a will be larger than the component $a \cos \alpha$, and hence there is an excess of light polarized in the radial plane.

In order to analyze the light of the corona and to record it on the photographic plate many devices might be used, but for the purposes of illustration we will take the double-image prism camera used in the eclipse of 1901. A double-image camera differs from an ordinary photographic camera in that a crystal of some doubly refracting substance, such as calcite, is placed in front of the lens. When the light from the Sun passes through these crystals it is broken into two beams and two images of the corona are found on the plate.

If the coronal light were unpolarized, the two images would be of equal intensity. If the light is polarized, one image will be stronger than the other along a certain line, but weaker along a line perpendicular to this. By measuring the difference in darkening of the two images, one is able to compute the percentage of polarized light at any point desired.

Although a single determination is subject to considerable error, yet by taking a great many observations at different points in the corona as well as on different plates, we can arrive at some fairly consistent values for the polarization. Below are tabulated the results obtained from all the plates deemed trustworthy of the 1901, 1905 and 1908 eclipses:—

Distance from the Sun's Limb.	Percentage of Polarized Light.
1′	18.0
2	24.7
3	33.2
4	37.8
5	37.4
6	36.6
7	37.0
8	35.1
9	35.8

If we return to the discussion of the theoretical value of the polarized light, we can see that it depends upon the distribution of the matter in the corona and the distance from the limb. If we assume any law for the distribution, we can calculate what should be the percentage of polarized light. Different laws were assumed until one was found which seemed to satisfy the observed facts. The results show that the matter in the corona falls off very rapidly as the inverse sixth or eighth power of the distance from the Sun's limb. It is also possible to calculate how much of the light is due to self-luminosity and how much to scattering. We shall not be very far wrong if we say that seventy-five per cent of the coronal light is due to the latter cause.

In the course of the work some difficulties were encountered which could not be entirely overcome. These could have been avoided by a suitable method of taking the photographs. The following suggestions may prove of some value to observers at future eclipses.

The intensity and polarization of the sky light about the corona should be measured. The outer corona differs very little in intensity from the sky background, and unless we have some definite knowledge of the sky light we cannot hope to extend the values for the polarization of the coronal light to any great distance from the Sun.

Standard squares should be imprinted upon each negative and the time of exposure of the standard squares should equal the time the plate is to be exposed to the corona. The difference in intensity of the standard squares may be produced by altering the distance of the plate from the source of light. In this way the conditions under which the standard squares are imprinted will agree with those under which the corona is photographed.

Finally, it might be well, though not so essential, to use a color screen or some other scheme to enable us to say definitely for what wave-length our results are quoted.

REYNOLD K. YOUNG.

THE D. O. MILLS OBSERVATORY.

Mr. D. O. MILLS's original gift to establish an observing station in the southern hemisphere provided for the active work of the observatory during the years 1903-06. In 1905 Mr. MILLS made provision for a second period of activity, from 1906 to 1911. After Mr. MILLS's lamented death, early in 1910, his son Mr. OGDEN MILLS, generously agreed to support the D. O. Mills Observatory during the years 1911 and 1912. It gives me pleasure to announce a recent gift from Mr. OGDEN MILLS in support of the observatory during a fourth period, embracing the years 1913 and 1914.

The staff of the observatory, located on the summit of Cerro San Cristobal, near Santiago, Chile, consists of Acting Astronomer JOSEPH H. MOORE, in charge; Mr. ROSCOE F. SANFORD, assistant, and Mrs. JOSEPH H. MOORE. Mr. GEORGE F. PADDOCK, who for five years was chief assistant at the observatory, has remained on the staff during the current year as a voluntary assistant, making his principal duties the investigation of certain spectroscopic binary stars.

W. W. CAMPBELL.

NOTE ON THE NUMBER OF OPTICAL PAIRS AMONG DOUBLE STARS WHOSE ANGULAR SEPARATION IS 5″ OR LESS.

In his "General Catalogue of Double Stars," BURNHAM has given diagrams for all pairs in which the observed motion has been sufficient to permit conclusions to be drawn as to its